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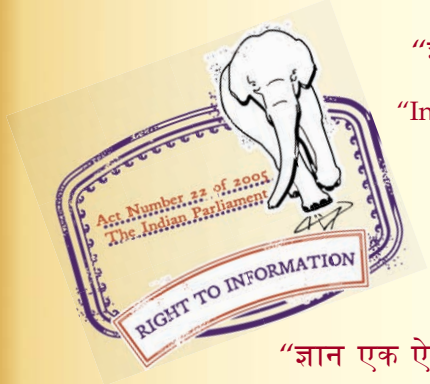

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"Knowledge is such a treasure which cannot be stolen"

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IS : 11472 (Part 1) - 1985
(Reaffirmed 2003)

Indian Standard

SPECIFICATION FOR ARTIFICIAL DAYLIGHT FOR THE ASSESSMENT OF COLOUR

PART 1 ILLUMINANT FOR COLOUR MATCHING AND COLOUR APPRAISAL

UDC 628·94 : 535·625·45 : 535·653·8

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Indian Standard

SPECIFICATION FOR ARTIFICIAL DAYLIGHT FOR THE ASSESSMENT OF COLOUR

PART 1 ILLUMINANT FOR COLOUR MATCHING AND COLOUR APPRAISAL

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Indian Standard

SPECIFICATION FOR ARTIFICIAL DAYLIGHT FOR THE ASSESSMENT OF COLOUR

PART 1 ILLUMINANT FOR COLOUR MATCHING AND COLOUR APPRAISAL

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Indian Standards Institution on 4 October 1985, after the draft finalized by the Illuminating Engineering and Luminaires Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The standard is divided into two Parts. Part 1 specifies an illuminant of given chromaticity and spectral distribution with a correlated colour temperature of 6 500°K, which is suitable for colour matching and colour appraisal. Part 2 states the viewing requirements applicable only to the graphic arts reproduction industry where a greater red content is required in the spectrum of the illuminant and for which, accordingly, a correlated colour temperature of 5 000°K has been selected.

0.3 This Part of the specification is concerned with an illuminant having the spectral composition based on a phase of daylight. As no artificial light source is likly to have this precise spectral composition the tolerances which light sources must meet in order to be suitable for colour matching and colour appraisal are defined.

0.4 New measurements on daylight have recently become available and the standard is now based on this work instead of on Standard Illuminant C used earlier. These measurements, and others of a different type made in recent years at a number of laboratories, indicate that the chromaticity of daylight most frequently occurring is similar to that adopted in the earlier specification, but on the green side of the full radiator locus. The correlated colour temperature of this region is close to 6 500°K, and the reconstituted spectral distribution for this colour temperature has been taken to provide the standard. The same distribution has recently been recommended by Experts' Committee E.1.3.1 of the International Commission on Illumination (CIE) as Standard Illuminant D 6 500 (*see* Appendix A).

0.5 A feature of these measurements has been the close similarity of curves from north sky observations on the one hand, and total sky observations, with or without sunlight, on the other, provided that these conditions refer to similar chromaticities.

0.6 This specification requires that artificial sources for colour matching shall satisfy two conditions. The first is that chromaticity of the light shall lie within certain limits, and the second is that the differences between its spectral distribution and that specifies shall be within certain limits.

0.7 As regards chromaticity the tolerance area is on the green side of the full radiator locus, in accordance with most determinations of the chromaticity of natural daylight.

0.8 Colour matches under sources conforming to this specification will hold in most phases of daylight. As in most cases materials may also be used under artifical light, especially that from incandescent tungsten lamps, colour matches should be checked under two sources (*see* Appendix B).

0.9 There are many instances in which a coloured object is inspected, not with a view to matching it with a standard, but to see if it harmonizes with some other coloured objects, or if its colour fits the observer's judgment of what is required. This may be called colour appraisal, which in critical cases is most often carried out in daylight. Light sources conforming to the specification are suitable for this purpose.

0.10 Some information on practical light sources is included in Appendix C.

NOTE — Fluorescent lamps referred to in IS : 2418(Part 1)-1977* and IS : 2418 (Part 2)-1977*, as 'colour matching' or 'northlight' may not necessarily comply with this specification. Lamps referred to as 'daylight' will not comply with this specification.

0.11 In the preparation of this standard assistance has been taken from BS 950: Part 1: 1967 'Specification for artificial daylight for the assessment of colour: Part 1 Illuminant for colour matching and colour appraisal', issued by the British Standards Institution.

0.12 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS: 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Specification for tubular fluorescent lamps for general lighting service:
Part 1 Requirements and tests (*first revision*).
Part 2 Standard lamp data sheets (*first revision*).

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 1) specifies an illuminant representing a phase of daylight, and the tolerances in both chromaticity and spectral distribution to which artificial light sources shall conform. This illuminant is suitable for colour matching and colour appraisal.

2. DEFINITIONS

2.0 For the purposes of this standard, the following definitions shall apply.

2.1 Ultra-Violet Range — The region of the spectrum which extends from 300 to 400 nm.

2.2 Colour Matching — The visual comparison under a suitable illuminant of two materials or fields, usually contiguous, for the purpose of judging their similarity in colour.

2.3 Colour Appraisal — The inspection of objects or surfaces under a suitable illuminant with a view to making subjective judgments on their colour characteristics. These judgments may vary between the extremes of colour matching and aesthetic appreciation of an isolated colour. Further examples are given in the Foreword.

3. CHROMATICITY OF ILLUMINANT

3.1 The chromaticity of the illuminant shall fall within the 12-sided figure shown in Fig. 1 with chromaticity co-ordinates shown in Table 1 and with a centre point given by $x = 0{\cdot}312\ 7$, $y = 0{\cdot}329\ 1$, on the 1931 CIE System.

4. SPECTRAL DISTRIBUTION OF ILLUMINANT

4.1 The spectral distribution is based on Appendix A. The spectral bend composition and tolerances shall be as shown in Table 2.

5. MAINTENANCE OF SPECTRAL DISTRIBUTION

5.1 The manufacturer of a light source or colour matching appliance shall declare the average number of hours running during which his product will conform to the specification.

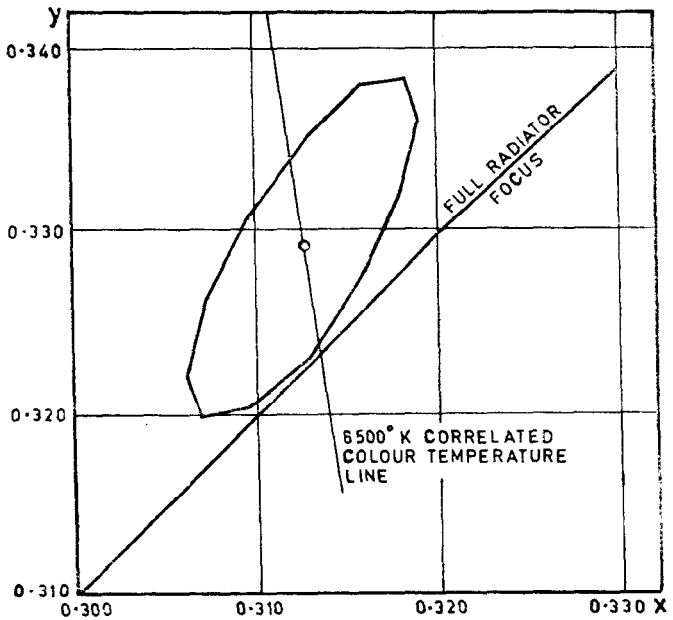

FIG. 1 CHROMATICITY DIAGRAM

TABLE 1 CHROMATICITY CO-ORDINATES

(*Clause* 3.1)

x	*y*
0·318 5	0·338 3
0·319 2	0·336 1
0·318 2	0·332 0
0·315 7	0·327 2
0·312 5	0·322 8
0·309 2	0·320 2
0·306 9	0·319 9
0·306 2	0·322 1
0·307 2	0·326 2
0·309 7	0·331 0
0·312 9	0·335 4
0·316 2	0·338 0

NOTE — The area surrounding the centre point is based on the standard deviations in colour matching. This 12-sided figure corresponds to a tolerance from the nominal chromaticity of 4 times the standard deviation in the direction of the minor axis, and 5 times in the direction of the major axis.

The purpose of this is to provide an adequate tolerance in lamp manufacture, while keeping well within the limits of daylight variation but avoiding any chromaticity below the full radiator locus.

TABLE 2 SPECTRAL DISTRIBUTION

(*Clause* 4.1)

Spectral Band	Wavelength Range	Band Value for 100 Lumen Flux	Percentage Tolerance in Band Value
(1)	(2)	(3)	(4)
	nm	mW	percent
U.V.a	300-340	11·2	± 30
U.V.b	340-400	43·2	± 30
		lm	
1	400-455	0·79	± 15
2	455-510	11·2	± 15
3	510-540	23·1	± 15
4	540-590	43·7	± 15
5	590-620	14·4	± 15
6	620-760	6·8	± 15

Note 1 — This method recommends the use of 10 percent tolerances on the band values, larger tolerances determined pirically are required at present in this specification to allow for the realization of the standard by fluorescent tubes of varied loading. The tolerances may be altered later if advances are made in providing better light sources. The purpose of these tolerances is to control spectral distribution rather than to colour rendering properties.

The CIE Test Colour method for measurement of colour rendering Publication No. 13 (1965) will be considered later as a requirement in this standard.

Note 2 — It is recommended that the level of illumination for colour matching shall be between 750 lux and 3 200 lux and the surroundings shall be natural in colour. The effects of finishes on lamp reflectors or fittings, or of spectrally selective transmission of plastic diffusers must be borne in mind when lighting installations are planned, since these variables may seriously alter the quality of the emitted light.

Standardized viewing conditions are also desirable because the level of illumination, background colour and brightness, glare and extraneous lighting will all affect the visual response.

Reference should also be made to the publication 'The IES Code, Recommendations for good interior lighting', published by Illuminating Engineering Society, UK, for further details appropriate application.

APPENDIX A

(*Clauses* 0.4 *and* 4.1)

SPECTRAL POWER DISTRIBUTION OF ARTIFICIAL DAYLIGHT D 6 500

Wavelength	*Relative Power per Unit Wavelength*	*Wavelength*	*Relative Power per Unit Wavelength*
nm		nm	
300	0·03	550	104·0
310	3·3	560	100 0
320	20·2	570	96·3
330	37·1	580	95·8
340	39·9	590	88·7
350	44·9	600	90·0
360	46·6	610	89·6
370	52·1	620	87·7
380	50·0	630	83·8
390	54·6	640	83·7
400	82·8	650	80·0
410	91·5	660	80·2
420	93·4	670	82·3
430	86·7	680	78·3
440	104·9	690	69·7
450	117·0	700	71·6
460	117·8	710	74·3
470	114·9	720	61·6
480	115·9	730	69·9
490	108·8	740	75·1
500	109·4	750	63·6
510	107·8	760	46·4
520	104·8	770	66·8
530	107·7	780	63·4
540	104·4		

APPENDIX B

(*Clause* 0.8)

METAMERIC MATCHES

B-1. When two coloured materials have identical spectral reflection curves they will be a visual match under any illuminant.

B-2. However, it is possible for two materials to match visually under a given light source without their being a spectral match and such matches are termed 'metameric'. They arise because the colouring matters used in each material are different, though this does not mean that spectral matches cannot be obtained unless identical colouring matters are used.

B-3. It is important to detect metamerism because materials which are a metameric match under one illuminant may not match under another illuminant whose spectral characteristics are significantly different. The simplest method of determining whether a match made under a light source conforming to the standard is metameric or not is to inspect it also under the light from a tungsten filament lamp and unless it is known that identifical colouring matters have been used, it is recommended that this be done. If the match still holds, it is unlikely to be metameric; if the materials no longer match, but the degree of mis-match is not serious, then it is unlikely that any greater degree of mis-match will occur under any other illuminant, natural or artificial.

B-4. A metameric match made under a light source conforming to this specification may not match under certain daylight conditions (for example north light from a blue sky or sunlight from a low sun), but it will match under the most frequently occurring phases of daylight. It must be noted, however, that when the degree of metamerism is severe the differences in normal colour vision of individual observers may result in two materials being a visual match for some observers, but a mis-match for others.

APPENDIX C

(*Clause* 0.10)

PRACTICAL SOURCES

C-1. The specification may be met by using different types of lamp, singly or in combination, with or withour filters.

C-2. If fluorescent lamps are used they should preferably be of low loading types: BW (1 500 mm); 65 W (1 500 mm); 40W (1 200 mm) or 20 W (600 mm); in order to minimize chromaticity differences and changes of relative ultra-violet emission due to lamp temperature changes. The disadvantages of enclosed unventilated fittings in this respect must also be considered.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2